



The Impacts of CIAT's Collaborative Research

The International Center for Tropical Agriculture (CIAT) is celebrating 50 years of collaborative work with hundreds of partners across the tropics. During 50 years, CIAT has led the development and dissemination of technologies, innovative methods, and new knowledge that better enable farmers to enhance eco-efficiency in agriculture and contribute to building a sustainable food future.

CIAT scientists have compiled an impressive record of achievements. In the interests of accountability to donors and other stakeholders, and to help lead the Center's strategic research investments, they have also devoted considerable effort to measure the economic impact of their work. This document reports some of the main impacts of CIAT's collaborative research, highlights key initiatives whose impacts have yet to be assessed, and describes several new studies and other efforts aimed to strengthen capacity for economic analysis.

BIG IMPACTS



BEANS



CASSAVA



TROPICAL FORAGES



RICE

Every US\$1 invested has generated

US\$3.22
in Latin
America and
the Caribbean
(LAC) and
sub-Saharan
Africa (SSA)

US\$2.28
globally and
US\$5.27
in Southeast
Asia alone

US\$1.86
in LAC
alone

US\$3.06
in LAC
alone

The adoption of CIAT-related varieties has generated economic benefits estimated at:

US\$17.4 billion
in LAC
and SSA

US\$9.2 billion
in LAC
and
Southeast
Asia

US\$1.58 billion
in LAC
alone

US\$10.8 billion
in LAC
alone

Note: All figures are in 2011 US dollars.



Common bean

HIGH RETURN ON INVESTMENT

CIAT has invested a total of US\$668.8 million in bean research globally over 50 years. CIAT partners have further invested around US\$3.9 billion in Latin America and US\$0.8 billion in sub-Saharan Africa to validate and disseminate new bean varieties during the same period. This combined investment has resulted in a benefit-cost ratio of 3.22, which entails a cumulative return of US\$17.4 billion from the adoption of CIAT-related varieties. The estimated internal rate of return for CIAT is 22.4 percent per year.

Note: All figures are in 2011 US dollars.

Investing in bean genetic improvement has been a major priority for CIAT during the last five decades. Thanks to a close collaboration with national agricultural research institutes, 357 CIAT-related bean varieties have been released in sub-Saharan Africa (SSA) and 322 in Latin America and the Caribbean (LAC) (CIAT, 2017a; Muthoni et al., 2017).

Nearly 4.9 million hectares planted to CIAT varieties in LAC and SSA

By 1999, CIAT-improved bean varieties were being planted to about 50% of the total bean area in LAC and almost 15% in SSA (Johnson et al., 2003a). By 2010, the adoption level had remained the same in LAC but had reached 45% in SSA. This means that, by 2014, there were around 4.9 million hectares planted to CIAT-related varieties (Muthoni and Andrade, 2015; Reyes, 2012).

Yield gains of 400 kg per hectare generated US\$116 million in the first 10 years of collaboration in Africa

The first 10 years of collaborative work between CIAT and several African bean programs led to significant yield gains of CIAT bean varieties over local varieties of around 400 kg per hectare. The resulting cumulative gross value of increased production was estimated at US\$116 million (Johnson et al., 2003a).

Over 90 thousand Rwandans and Ugandans lifted out of poverty in 2011

In 2011, CIAT-improved bean varieties released in Rwanda and Uganda showed yield gains of between 43 and 82% compared to local landraces, which translated into 90 thousand people lifted out of poverty and more than 182 thousand people less food insecure during that year (Laroche et al., 2015).

Almost 350 thousand Rwandan households growing high-iron beans

The collaboration of CIAT with the Rwanda Agriculture Board (RAB) and HarvestPlus resulted in the release of 10 high-iron bean varieties in Rwanda by 2012. Four years later, it was estimated that around 350 thousand Rwandan households were growing these biofortified varieties. Consequently, when productivity reaches sufficient levels, 1.75 million people will be able to consume these more nutritious beans (Asare-Marfo et al., 2016).

DRIVERS FOR ADOPTION



Access to off-farm income, use of animal traction, larger farm size, and access to extension services and credit are among the drivers for the adoption of improved bean varieties (Hamzakaza et al., 2014; Letaa et al., 2015; Lopes, 2010).

Less conventional drivers such as owning a cell phone, access to agricultural subsidy programs, and a perception of negative climate shocks (drought, flooding, and unusual rain patterns) also positively influence adoption (Katungi et al., 2017; Laroche et al., 2014).



Low soil fertility, larger household size, and male-headed households, on the contrary, tend to discourage farmers' decision to adopt improved varieties (Laroche et al., 2014; Letaa et al., 2015).



CIAT has invested a total US\$378.4 million in cassava research globally since the 1970s. CIAT partners have further invested some US\$3.7 billion in LAC and Southeast Asia to validate and disseminate new cassava varieties during the same period. This combined investment has resulted in a benefit-cost ratio of 2.28, which entails a cumulative return of US\$9.2 billion from the adoption of CIAT-related varieties. It is worth highlighting that most of the returns on CIAT cassava research come from Southeast Asia, where the benefit-cost ratio has reached 5.27. The estimated internal rate of return for CIAT is 15.5 percent per year globally while for Southeast Asia only, it is 21.2 percent per year.

Note: All figures are in 2011 US dollars.

CIAT's Cassava Program started its collaboration with national agricultural research programs in LAC in 1973 and in Southeast Asia in 1983. As a result, 35 improved cassava varieties have been released in LAC and 25 in Southeast Asia (CIAT, 2017b).

Two-thirds of the total cassava area is planted to CIAT-related varieties in Thailand, Vietnam, China, Indonesia, and the Philippines

By 1998, CIAT-related varieties were planted in 57% of Thailand's 1.2 million hectares sown to cassava, and in 23.4% of the total cassava area of Thailand, Vietnam, China, Indonesia, and the Philippines (Johnson et al., 2003b). As CIAT-related varieties continued to spread, 2.33 million ha of cassava were under CIAT varieties by 2014, representing an adoption rate of 66.6% in these five countries (Labarta et al., 2017a).

Improved cassava had generated US\$440 million by 1998

The gross economic value generated by improved cassava was estimated at almost US\$440 million by 1998, with an internal rate of return in the range of 9 to 22% (Johnson et al., 2003b).

KU50 variety alone generated US\$393.5 million in Thailand and Vietnam between 1992 and 2010

Kasetsart 50 or KU50, a cassava variety bred in Thailand through a collaboration between Kasetsart University and CIAT's Cassava Program, has been identified as the most used cassava variety in Asia. It is estimated that there are around 1.3 million hectares sown to this variety in Thailand. The economic impact of this variety only in Thailand and Vietnam between 1992 and 2010 is estimated at US\$393.5 million (Robinson and Srinivasan, 2013).

KM140 variety released in 2013 already found on more than 38% of Vietnam's cassava fields

Using DNA fingerprinting as a novel method to identify cassava varieties in farmers' fields has demonstrated a fast uptake of a new CIAT variety released in 2013 in Vietnam. This variety, called KM140, has become the dominant variety among cassava growers, covering 38.7 percent of the total cassava area in the country (Le et al., 2017).

DRIVERS FOR ADOPTION



In Latin America, larger farms have been the main adopters of CIAT-related cassava varieties, while in Southeast Asia adopters tend to be more educated farmers who use a larger number of varieties and apply fertilizer.



In Colombia, farmers who own their cassava plots tend not to adopt improved varieties.

In Vietnam, farmers with higher numbers of cassava plots and larger family size show the same tendency (Floro et al., 2018; Le et al., 2017).



CIAT has invested a total of US\$407.7 million in tropical forages research globally over 50 years. CIAT partners have further invested around US\$440.7 million in Latin America¹ to validate and disseminate new forages during the same period. This combined investment has resulted in a benefit-cost ratio of 1.86, which entails a cumulative return of US\$1.58 billion from the adoption of CIAT-related varieties. The estimated internal rate of return for CIAT is 14.02 percent per year.

Note: All figures are in 2011 US dollars.

¹ This information only accounts for five countries: Peru, Colombia, Nicaragua, Honduras, and Costa Rica.

***Brachiaria* grasses found on 3.76 million hectares in Colombia, Nicaragua, Honduras, Costa Rica, and Peru**

In Latin America, superior *Brachiaria* grasses, many of them introduced and promoted by CIAT, have been widely adopted in tropical areas of the continent. In Colombia, Nicaragua, Honduras, Costa Rica, and Peru, they are estimated to cover an area of 3.76 million hectares, which represents 28.3 percent of the total tropical forages area in these countries (Labarta et al., 2017b).

Over 15 thousand Southeast Asian smallholders use improved forages in CIAT project areas

In Southeast Asia, improved tropical forages have been widely adopted since the start of their promotion in 1995. Although adoption is difficult to measure with precision, it is estimated that more than 15 thousand smallholders have adopted various forage species in CIAT project areas (Martin, 2010; Stür et al., 2005).

DRIVERS FOR ADOPTION



In Colombia, the adoption of *Brachiaria* grasses promoted by CIAT is more common among specialized livestock producers. Ranchers with more assets, intense labor use, and better access to credit are also more likely to adopt *Brachiaria* grasses.



In Colombia, larger farms show low adoption of these forages. Female-headed households and farms with higher labor wages also show the same tendency (Labarta et al., 2017b).



Rice

CIAT has invested a total of US\$361 million in rice research over 50 years in Latin America. CIAT partners in the region have further invested around US\$3.15 billion to validate and disseminate new rice varieties during the same period. This combined investment has resulted in a benefit-cost ratio of 3.06, which entails a cumulative return of US\$10.8 billion from the adoption of CIAT-related varieties. The estimated internal rate of return for CIAT is 13.2 percent per year.

Note: All figures are in 2011 US dollars.

CIAT and FLAR had released 299 rice varieties through 23 national programs in LAC by 2003

By 2003, CIAT and the Latin American Fund for Irrigated Rice (FLAR) had participated in the release of 299 rice varieties through 23 national programs in Latin America (Hossain et al., 2003). By 2012, nearly 60% of all of the improved rice varieties released in LAC were believed to contain germplasm developed by CIAT (Yamano et al., 2016).

Rice yields double in Colombia between 1970 and 1975

CIAT rice research in Colombia in collaboration with the Colombian Agricultural Institute (ICA) started in 1970 and produced very quick impacts in the rice sector. After 5 years of collaboration, 27% of the total rice area was already under new CIAT varieties, and yields increased from 2.2 to 4.4 t/ha (Scobie and Posada, 1978).

Improved rice varieties generated US\$860 million between 1967 and 1995

According to studies conducted in the late 1990s, CIAT-related rice varieties had generated aggregated benefits worth US\$860 million for the period 1967–1995. Rice consumers are the main beneficiaries, receiving almost 60% of all the gains generated thanks to lower prices (Sanint and Wood, 1998).

CIAT investment in the Andes and in Central America has generated US\$314.4 million in the last 15 years

By 2010, around 63.5% of the 1.33 million hectares of the area under rice in the Andean and Central American regions were planted to CIAT genetic material. Returns on CIAT investments in rice improvement in these regions over the last 15 years have been estimated at US\$314.4 million (Yamano et al., 2016).

DRIVERS FOR ADOPTION

- ✓ Uptake of CIAT-related varieties in Latin America has been associated with several factors, including larger farm size, higher level of education of household head, market-oriented production, and household membership to producer associations.
- ✗ Rice varietal traits such as early maturity and high input requirements have limited adoption (Marín et al., 2017; Martínez, 2015).



Soils and landscapes

Better practices reduce environmental impact of cassava production and boost yields in Southeast Asia

Between 1993 and 2003, CIAT led the dissemination of crop management and soil conservation practices in cassava-based systems in Southeast Asia. The participatory research approach implemented resulted in a significant increase in the use of hedgerows, counter ridges, farmyard manure, and inorganic fertilizer (between 53 and 91%). This initiative not only contributed to mitigating the environmental impacts of the expansion of cassava farming into hillier areas, it also boosted cassava yields and therefore farm income (Dalton et al., 2011).

Arable layers can increase soy and maize yields by up to 59% in Colombia's Eastern Plains

During the early 2000s, CIAT developed an innovative technology to build up arable layers on the infertile acid soils of the Eastern Plains (Llanos) of Colombia. Research has demonstrated that using this practice could increase soy and maize yields between 38 and 59 percent. Most notably, this initiative made it possible to grow 2,000 hectares of maize, a crop new to this area (Rivas et al., 2004).

Linking farmers to markets and food systems

Colombian coffee growers increase household income by US\$2,220 a year

The Borderlands project implemented by CIAT and Catholic Relief Services (CRS) in Colombia and Ecuador in 2012–2016 used CIAT's LINK methodology to support the

renewal and certification of coffee plantations. In Colombia's Nariño Department, this intervention enabled farmers to earn substantial price premiums and increase the coffee production area and yields, resulting in an increase of coffee growers' annual income of US\$2,220 per household (Vellema et al., 2005).

Milk productivity increases by 28% thanks to better access to assets and services in Nicaragua

CIAT and CRS worked together in 2013–2016 to increase Nicaraguan livestock producers' access to productive assets and services (including forages and management practices) and new markets by bringing their products up to the required standards. This intervention resulted in an increase of milk productivity of around 0.9 liters of milk per cow per day, a 28% increase (Pinillos et al., 2017).

Participatory research and gender analysis

98 local agricultural research committees (CIALs) still active in Honduras in 2006

CIAT has been a leader in participatory agricultural research. A major contribution in this area has been the development of local agricultural research committees (CIALs, its Spanish acronym) in Colombia, Honduras, Ecuador, Bolivia, Brazil, Nicaragua, El Salvador, and Venezuela since 1993. Although this research initiative was formally discontinued in recent years, 98 CIALs were still active throughout Honduras in 2006 and constituted a primary source of agricultural technology in the country (Reyes, 2012; Wettasinha et al., 2014).



Participatory plant breeding leads to faster uptake of new crop varieties and increases women participation

CIAT researchers working with Latin American partners found that participatory plant breeding increases crop diversity and breeding knowledge, as well as empowers farmers. This, in turn, leads to a faster uptake of improved crop varieties and increases participation of women in farmers' groups. Notably, Honduran CIALs had generated 23 new bean varieties by 2016 using advanced CIAT lines, and women represented 42% of the CIALs membership (Humphries, 2016).

CIAT participatory research approach involves community and helps maintain forested buffer zones in the Cabuyal watershed, Colombia

CIAT participatory research approach was crucial to facilitate the involvement of the Cabuyal watershed community in Colombia to influence the change of a national environmental policy. By improving farmers' capacity to identify problems, set priorities, and negotiate solutions, the watershed community participated in policy making aimed at maintaining forested buffer zones around water springs and courses. This initiative also resulted in 150 thousand trees planted on 35 hectares in the watershed (Ravnborg and Ashby, 1996).

Female participation in varietal selection significantly increases the adoption of modern rice varieties in Ecuador

Gender analysis is an important component of CIAT's social science research, and the Center has been an undisputable leader in promoting the approach in the CGIAR System. Gender analysis shows evidence that female participation

in varietal selection significantly increases the adoption of modern rice varieties in Ecuador. Female participation in strategic decisions related to the adoption of novel technologies has also been shown to benefit the household wellbeing (Orrego et al., 2016; Twyman et al., 2015).

Capacity strengthening

CIAT has contributed importantly to increasing the knowledge pool and strengthening the capacity of its many research partners. More than 13,000 professionals from Latin America, Africa, and Asia have benefited from training offered by the Center (CIAT, 2011). About half of these people have participated in specialized courses or workshops, while about 35% have received individual training. The remainder did thesis research at CIAT for postgraduate degrees.

Documenting broader CIAT impacts: Current challenges and future priorities

While CIAT has been involved in nearly every aspect of tropical agriculture in the last 50 years, most impacts documented so far are related to commodity research. There are several reasons for that. First, 89% of CIAT's total investment has been devoted to commodity research. Second, with a long history in commodity research, there has been enough time to observe the impacts related to this work. Finally, from a methodological point of view, impact assessment has made great progress in measuring the outcomes and impacts of genetic crop improvement and crop management practices.

But in the last 20 years, other research areas have also become priorities for CIAT and are starting to show evidence of outcomes and impacts. While this presents an opportunity to document CIAT's impacts beyond commodity crops, assessing the impacts of research related to genetic resource conservation, natural resource management, development of business models, and policy incidence, poses a number of challenges.

First of all, establishing a clear causal effect between CIAT research and the impacts observed is not always straightforward. Many initiatives are still in their early stages and might need more time to exhibit observable changes, if any at all. Finally, impacts often depend on factors that are beyond the control of CIAT and its partners, and measuring the specific effects of CIAT research might require further methodological developments.

Nevertheless, this section showcases impact stories that have been prioritized for ongoing and future CIAT's impact assessment efforts.

Genetic resources

CIAT's genebank safeguards the world's largest and most diverse collections of beans, cassava, and tropical forages, with a total of 67,700 accessions. This material has contributed importantly to crop breeding at CIAT and has been shared with national research programs, universities, partners, and farmers in more than 160 countries. Measuring the economic returns of conserving and sharing crop genetic resources is a challenging task. Traditionally, returns have been measured based on the adoption of specific improved varieties. But today, CIAT is collaborating with the University of Minnesota in a novel initiative aimed at assessing the impacts of adopting crosses bred using CIAT genetic material. This initiative uses diverse datasets to help guide and provide insights to effective breeding strategies, cope with climate change, and better understand the drivers behind technology adoption.

Climate change

CIAT research revealed severe negative effects of climate change on coffee suitability in Nicaragua by 2050. This research informed the design of the 2013 National Adaptation Plan for Agriculture (NAPA) on potential adaptation strategies in the coffee sector, helping mobilize US\$24 million from the International Fund for Agricultural Development (IFAD) to support Nicaragua's climate adaptation efforts.

This is a significant outcome for CIAT. However, studies suggest that coffee growers in Nicaragua are not yet implementing the recommendations framed in the NAPA, which suggests that they may not have access to this information (Zuluaga et al., 2015). With more time, CIAT expects to be able to reach farmers and agricultural practitioners and ensure that its recommendations are put in place.

Ecosystem services

CIAT and the Zamorano Pan-American Agricultural School in Honduras developed an automated tool called AGRI (AGua para Riego [water for irrigation]) to analyze the availability of water sources for small-scale irrigation projects, potential water intake points, and sites for rainwater harvesting, as well as identify viable route options to carry water by gravity (without the use of fossil fuels) from the source to farmers' fields. This tool has raised the interest of high-level decision makers and could benefit farmers facing severe water constraints, especially in the Dry Corridor of Central America. With a growing demand from development and public organizations in Central America to design and



scale up water management interventions (i.e. water harvesting technologies), the potential future impacts of this tool are considerable.

Sustainable food systems

During the last decades, CIAT has developed diverse methodologies to establish inclusive commercial relationships and link farmers to markets. Research evidence shows that farmers in Nicaragua who belong to inclusive value chains could increase their sales volume by 27 percent. Furthermore, it is estimated that bean and tomato wholesalers who promote inclusive practices could save at least 7.5 and 5.8 thousand metric tons, respectively, or US\$8.55 million in averted loss (Reyes et al., 2016). CIAT is currently promoting interventions designed to develop more inclusive business models in informal and formal markets for different food products in Central America and Southeast Asia, and aims to keep track of the impacts in the whole food system.

Pest and disease management

CIAT crop protection team belongs to the global research network on integrated monitoring and management of cassava pests and diseases in Latin America and Southeast Asia. In particular, the network shares alerts and diagnostic tools, and convenes emergency meetings with national plant protection authorities in countries such as Thailand, the Philippines, Vietnam, and Cambodia, and representatives from the United Nations Development Programme (UNDP), Food and Agriculture Organization of the United Nations (FAO), and ministries of agriculture and the environment – to join efforts to better understand the threat posed by the

cassava mosaic disease in the region, and explore potential control measures.

CIAT is currently involved in seven initiatives in Southeast Asia, supported by FAO, the Australian Centre for International Agricultural Research (ACIAR), and the Philippine Department of Agriculture. Monitoring tools, such as PestDisPlace (<http://pdp.ciat.cgiar.org/>), have been developed to keep track of pests and diseases in collaboration with national plant protection organizations for timely warnings on biological threats. Early detection of newly introduced biological threats has also been used to implement preventive breeding in Andean beans and in rice.

CIAT has played a leading role in promoting pest and disease monitoring – not limited to its mandate crops – and the related technology and tools along with expert networks are expected to bring significant benefits to Southeast Asia.

Integrated soil fertility management

The integrated soil fertility management (ISFM) approach has been extensively studied and validated in many regions across the world. It seeks to sustainably intensify crop production through a combination of improved crop varieties and the application of both mineral fertilizers and organic inputs. In spite of its potential to combat soil fertility depletion in vast areas – a problem that threatens global food security – the adoption of ISFM has been very low. ISFM is another example of technology that requires an extended period of time for farmers to realize its benefits. ISFM is being increasingly mainstreamed into national policies, but the results will take time to materialize.

The way forward

CIAT and the CGIAR System as a whole are undergoing significant and rapid changes in the way they are designing and implementing their research agendas, including putting stronger emphasis on natural resource management, food systems, and policy incidence. CIAT's impact assessment efforts will need to keep pace and provide more evidence of CIAT's impact in these areas. Internally, CIAT is implementing a more integrated evaluation framework guided by institutional learning and involving greater coordination between impact

assessment, monitoring and evaluation, and foresight activities.

CIAT impact assessment research reveals the importance of strategic partnerships to improve assessment methods and procedures. In order to continuously strengthen its capacity to effectively document its outcomes and impacts, and respond to the CGIAR System requirements, CIAT is working with other CGIAR Centers, US universities, advanced research institutes, HarvestPlus, and a network of national partners.



CGIAR is a global research partnership for a food-secure future. Its research is carried out by 15 CGIAR centers in close collaboration with hundreds of partners.

References

- Asare-Marfo D; Herrington C; Alwang J; Birachi E; Birol E; Diressie M; Dusenget L; Funes J; Katungi E; Labarta R; Larochelle C; Katsvairo L; Lividini K; Lubowa A; Moursi M; Mulambu J; Murekezi A; Musoni A; Nkundimana J; Oparinde A; Vaiknoras K; Zeller M. 2016. Assessing the adoption of high-iron bean varieties and their impact on iron intakes and other livelihood outcomes in Rwanda: Listing exercise report. IFPRI Report. International Food Policy Research Institute: Washington DC, United States.
- CIAT. 2011. Capacity strengthening. Centro Internacional de Agricultura Tropical (CIAT), Cali, Colombia. <http://hdl.handle.net/10568/41702>
- CIAT. 2017a. Centro Internacional de Agricultura Tropical – Latin America and the Caribbean Bean Releases 1978-Present. Bean Program Database. Centro Internacional de Agricultura Tropical (CIAT), Cali, Colombia.
- CIAT. 2017b. Cultivares Yuca Monitoring-Evaluation. Cassava Program Database. Centro Internacional de Agricultura Tropical (CIAT), Cali, Colombia.
- Dalton TJ; Lilja NK; Johnson N; Howeler R. 2011. Farmer participatory research and soil conservation in Southeast Asian cassava systems. *World Development* 39(12):2176–2186.
- Floro V; Labarta R; Becerra L; Martínez J; Ovalle T. 2018. Household determinants of the adoption of improved cassava varieties using DNA fingerprinting to identify varieties in farmer fields: a case study in Colombia. *Journal of Agricultural Economics* (forthcoming).
- Hamzakaza P; Katungi E; Reyes B; Maredia M; Muimui K; Ojara M. 2014. Assessing access and adoption of common bean improved varieties in Zambia. Research Technical Report. Zambian Agricultural Research Institute, International Center for Tropical Agriculture (CIAT), and Michigan State University. Lusaka, Zambia.
- Hossain M; Gollin D; Cabanilla V; Cabrera E; Jhonson N; Khush G; McLaren G. 2003. International Research and Genetic Improvement in Rice: Evidence from Asia and Latin America. In: Evenson RE; Gollin D. (eds.). *Crop variety improvement and its effect on productivity: the impact of international agricultural research*. CABI Publishing, Cambridge, USA. p. 71–100.
- Humphries S. 2016. Participatory research and plant breeding in Honduras: improving livelihoods, transforming gender relations.
- Johnson NL; Pachico D; Wortmann CS. 2003a. The impact of CIAT's genetic improvement research on beans. In: Evenson RE; Gollin D. (eds.). *Crop variety improvement and its effect on productivity: the impact of international agricultural research*. CABI Publishing, Cambridge, USA. p. 257–274.
- Johnson NL; Manyong VM; Dixon AGO; Pachico D. 2003b. The impact of IARC genetic improvement programmes on cassava. In: Evenson RE; Gollin D. (eds.). *Crop variety improvement and its effect on productivity: the impact of international agricultural research*. CABI Publishing, Cambridge, USA. p. 337–355.
- Katungi E; Magreta R; Letaa E; Chirwa R; Dambuleni K; Nyamwaro S. 2017. Adoption and impact of improved bean varieties on food security in Malawi. PABRA report. Pan-Africa Bean Research Alliance (PABRA), Lilongwe, Malawi.
- Labarta R; Wossen T; Le DP. 2017a. Adoption of improved cassava varieties in South and Southeast Asia. Paper presented at the Asian Society of Agricultural Economics. Bangkok, Thailand, 11–13 January.
- Labarta R; Martínez J; Yaccelga A; Reyes B; Gómez L; Maredia M; DeYoung D; Carriazo F; Toro M. 2017b. Assessing the adoption and economic and environmental impacts of *Brachiaria* grass forage cultivars in Latin America focusing on the experience of Colombia. SPIA Technical Report. Standing Panel for Impact Assessment (SPIA), Rome, Italy.
- Larochelle C; Alwang J; Katungi E; Norton G. 2014. Constraints and factors influencing adoption of improved bean varieties in Rwanda and Uganda and improved Irish potato in Rwanda. SPIA Report. Standing Panel for Impact Assessment (SPIA), Rome, Italy.
- Larochelle C; Alwang J; Norton G; Katungi E; Labarta R. 2015. Chapter 16: Impacts of improved bean varieties on poverty and food security in Uganda and Rwanda. In: Walker TS; Alwang J. (eds.). *Crop improvement, adoption, and impact of improved varieties in food crops in sub-Saharan Africa*. CABI: United Kingdom.
- Le DP; Labarta R; Becerra L; Ovalle T; De Han S. 2017. Identifying the determinants of adopting modern cassava varieties in Vietnam using DNA fingerprinting approach. CIAT Working Document (forthcoming). Centro Internacional de Agricultura Tropical (CIAT), Cali, Colombia.
- Letaa E; Kabumgo C; Katungi E; Ojara M; Ndunguru A. 2015. Farm level adoption and spatial diffusion of improved common bean varieties in Southern highlands of Tanzania. *African Crop Science Journal*. 23(3):261–277.
- Lopes H. 2010. Adoption of improved maize and common bean varieties in Mozambique. MSc Thesis. Department of Agricultural, Food and Resource Economics Department. Michigan State University. East Lansing, United States.
- Marín D; Orrego M; Andrade R; Mendoza L; Yanez F; Labarta R. 2017. Understanding adoption of rice improved varieties in Ecuador using a mixed logit approach. CIAT Working Document. Centro Internacional de Agricultura Tropical (CIAT), Cali, Colombia.
- Martin G. 2010. ACIAR investment in research on forages in Indonesia. ACIAR Impact Assessment Series Report No. 65. Australian Centre for International Agricultural Research (ACIAR), Canberra. 59 p.
- Martínez, J. 2015. Technology adoption among Bolivian rice farmers. A multivariate approach. MSc Thesis. Economics Department, Universidad del Valle, Cali, Colombia.

- Muthoni R; Andrade R. 2015. Chapter 8: The performance of bean improvement programmes in sub-Saharan Africa from the perspectives of varietal output and adoption. In: Walker TS; Alwang J. (eds.). Crop improvement, adoption, and impact of improved varieties in food crops in sub-Saharan Africa. CABI: United Kingdom.
- Muthoni-Andriatsitohaina R; Nagadya R; Okii D; Obilil I; Mukankusi C; Chirwa R; Zulu R; Lungaho M; Ruranduma C; Ugen M; Kidane T; Karanja D; Mazuma E; Musoni A; Sefume L; Meshac T; Amane M; Fourie D; Dlamini A; Andriamazaoro H; Kilango M; Kweka O; Mutari B; Mumui K; Asibuo J; Nguiguim M. 2017. Common bean variety releases in Africa. Harvard Dataverse, V1.
- Orrego M; Marín D; Yanez F; Mendoza L; García M; Twyman J; Labarta R. 2016. Estudio de adopción de variedades modernas y prácticas agronómicas mejoradas de arroz en Ecuador. Reporte de Investigación. Instituto Nacional de Investigación Agrícola y Pecuaria, Centro Internacional de Agricultura Tropical (CIAT), Cali, Colombia.
- Pinillos J; Labarta R; González C; Álvarez D. 2017. Attrition bias in productivity and food security impacts: a case study in the Nicaragua's livestock sector. Paper accepted for presentation in the Interconference symposium of the International Association of Agricultural Economics, Talca, Chile. 17-20 October 2017.
- Ravnborg H; Ashby J. 1996. Organizing for local watershed management: lessons from Río Cabuyal watershed, Colombia. AGREN, ODI, Network Paper 65.
- Reyes B. 2012. The economic impact of improved bean varieties and determinants of market participation: evidence from Latin America and Angola. PhD Thesis. Department of Agricultural, Food and Resource Economics Department. Michigan State University, East Lansing, United States.
- Reyes B; Larosa F; Gómez L; Buritica A; Jäger M; Lundy M; Weigel J. 2016. Mercados informales para reducir la pobreza y para seguridad alimentaria: Explorando opciones políticas en Nicaragua y Honduras.
- Rivas L; Hoyos P; Amézquita E; Molina D. 2004. Manejo y uso de los suelos de la Altillanura Colombiana. CIAT report. Centro Internacional de Agricultura Tropical (CIAT), Cali, Colombia.
- Robinson J; Srinivasan CS. 2013. Case-studies on the impact of germplasm collection, conservation, characterization and evaluation (GCCCE) in the CGIAR. SPIA Report. Standing Panel for Impact Assessment (SPIA), Rome, Italy.
- Sanint L; Wood S. 1998. Impacto de la investigación del arroz en Latinoamérica y el Caribe durante las tres últimas décadas. Instituto Interamericano de Cooperación para la Agricultura (IICA); Banco Interamericano de Desarrollo (BID); Instituto Internacional de Investigación sobre Políticas Alimentarias (IFPRI), San José, Costa Rica. 24 p. (Priorización de la investigación agropecuaria en América Latina y el Caribe No. 3).
- Scobie G; Posada R. 1978. The impact of technological change on income distribution: rice in Latin America. American Journal of Agricultural Economics 60(1):85-92.
- Stür W; Connell J; Phengsavan P; Khanh TT. 2005. Unlocking the potential of smallholder livestock production - using managed forages as an entry point. International Center for Tropical Agriculture (CIAT), Vientiane, Lao PDR. 1 p.
- Twyman J; Muriel J; García M. 2015. Identifying women farmers: informal gender norms as institutional barriers to recognizing women's contribution to agriculture. Journal of Gender, Agriculture and Food Security. 1(2):1-17.
- Vellema W; Buritica Casanova A; González C; D'Haese M. 2005. The effect of specialty coffee certification on household livelihood strategies and specialization. Food Policy.
- Wettasinha C; Walter-Bayer A; van Veldhuizen L; Quiroga G; Swaans K. 2014. Study on impacts of farmer-led research supported by civil society organizations. Penang, Malaysia. CGIAR Research Program on Aquatic Agricultural Systems. Working Paper: AAS 2014-40.
- Yamano T; Aminou A; Labarta R; Huelgas ZM; Mohanty S. 2016. Adoption and impacts of international rice research. Global Food Security 8:1-8.
- Zuluaga V; Labarta R; Läderach P. 2015. Climate change adaptation: the case of the coffee sector in Nicaragua. Selected Paper prepared for presentation at the 2015 Agricultural & Applied Economics Association and Western Agricultural Economics Association Annual Meeting, San Francisco, CA, 26-28 July.

CONTACT

Ricardo Labarta

Leader, Impact Assessment Research

✉ r.labarta@cgiar.org

www.ciat.cgiar.org



Building a sustainable food future
since 1967



CIAT is a CGIAR Research Center